

February 11, 2019

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California Public Utilities Commission  
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**Subject: Petition of the California Solar & Storage Association for Modification of Resolution E-4832 and Resolution E-4898**

Director Randolph,

With this letter and the attached Petition, the California Solar & Storage Association (CALSSA) requests that the California Public Utilities Commission (Commission) modify Resolution E-4832 and Resolution E-4898 (Resolutions). Resolution E-4832 approved Advice Letter 3023-E from San Diego Gas & Electric (SDG&E), Advice Letter 3532-E from Southern California Edison (SCE), and Advice Letter 4982-E from Pacific Gas and Electric (PG&E), implementing Phase II smart inverter requirements (Phase II Advice Letters). Resolution E-4898 approved SDG&E Advice Letter 3106-E, SCE Advice Letter 3647-E, and PG&E Advice Letter 5129-E, implementing Phase III smart inverter requirements (Phase III Advice Letters).

As explained in the attached Petition, the Resolutions relied on a consensus process to develop details that were not contained in the Advice Letters. When the investor-owned utilities issued more detailed implementation plans, it became apparent that parties were far from reaching consensus on certain issues. CALSSA requests that the Commission modify the Resolutions to require the advice letters to include more details and not to exceed areas of consensus.

Thank you for your assistance on this urgent matter.

Respectfully,

/s/ Brad Heavner  
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**PETITION OF THE  
CALIFORNIA SOLAR & STORAGE ASSOCIATION  
FOR MODIFICATION OF RESOLUTION E-4832 AND RESOLUTION E-4898**

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## 1. Introduction

California has been at the forefront of developing advanced inverter functionality. Unlike Hawaii and Germany, where solar penetration exceeded grid capabilities before inverter-based tools were deployed to help the grid handle high solar penetration, California has sought to stay ahead of grid needs by incorporating functionality before limits are exceeded. The Smart Inverter Working Group (SIWG) has gone ahead of the national standards-setting bodies that are the normal forum for developing new requirements. The California Public Utilities Commission (Commission) and the California Energy Commission (CEC) have pushed the SIWG to develop technical standards for inverter functions before operational requirements or market mechanisms are developed to make use of those functions. The Commission has sought to require customers to have the *capability* to perform grid support functions before requiring customers to *operate* those functions.

For Phase I functions, the timing of the capability requirement ended up coinciding with the operational requirement. Starting September 8, 2017, customers were required to install inverters that had the capability to perform those functions and the functions had to be actively used. Those functions solved the major reliability concerns related to increased customer adoption of solar energy systems.

For Phase II functions and Phase III Functions 1 and 8, requirements for the capability to perform the functions will be effective before any requirements are established for how to implement and use the capabilities. The most important objective for those functions at this stage is *interoperability*. Equipment installed now should be shown to work with devices or entities that will communicate with utilities in the future according to Standard 2030.5-2018 of the Institute of Electrical and Electronics Engineers (IEEE) as defined in the Common Smart Inverter Profile (CSIP). Assuming that customers installing systems now will one day be

required or encouraged to use communications, the Commission should have confidence that the equipment that gets installed now will be interoperable with communications equipment managed by aggregators or available for installation onsite.

The Phase II Advice Letters and Phase III Advice Letters are out of compliance with Commission order because they did not specify important implementation details and the level of agreement that existed on those details. As described below, the decision underlying the Advice Letters ordered the investor-owned utilities (IOUs) to propose changes to Rule 21 based on consensus agreements. Implementation plans circulated by the IOUs after the Resolutions were approved had additional items that were far beyond the agreed-upon specifications necessary to implement smart inverter standards. In light of those plans, the Commission should modify the Resolutions to require the advice letters to include relevant details. The three largest flaws in the implementation plans are:

1. SDG&E's plan requires functionality at the inverter level that is inconsistent with agreements of the SIWG and IEEE.
2. SDG&E's plan requires undefined, utility-led testing that is inconsistent with agreements to rely on testing developed by the SunSpec Alliance. PG&E's plan states that the utility may later decide to require such testing.
3. The IOU plans require active contracts or installed equipment that are beyond the level of stakeholder agreement.

The California Solar & Storage Association (CALSSA) appreciates that the Commission has consistently pushed California market participants to have a leadership position. However, requiring capabilities before requiring operation carries the risk of the requirements being out of step with what is fair to customers or practical in the marketplace. Such a mismatch has become

apparent with the proposed implementation plans for Phase II and Phase III smart inverter requirements.

## **2. Timing of this Petition**

Rule 8.2 of General Order 96-B requires adherence to Rule 16.4(d) of the Commission's Rules of Practice and Procedure, which states that if a petition for modification is not filed within one year of the effective date of a decision it must state why it could not have been filed by that time. The Resolutions were based on language in D.16-06-052 that lacked specific direction and anticipated that parties would develop consensus positions. When the IOUs submitted the Phase II Advice Letters in December 2016, there was still hope that a collaborative process would lead to a reasonable outcome. When the Commission issued Resolution E-4832 in April 2017 approving those advice letters, it was still not clear whether there would be agreement on implementation details or whether separate requirements for operation of those functions would be in place before the deadline to include the capabilities.

The SIWG has been a consensus-based process that has involved a great deal of trust that technical specifications for functional capabilities would not get too far ahead of requirements for operations. Participants were pushed to accept that customers would not incur significant expense before costs and benefits were evaluated, particularly for functions that go beyond addressing the impacts to the grid of an individual customer's installation. It would have been premature to petition for a change to the Resolutions before the compliance deadline was set or before it was clear that requirements for operations would not be developed until after the compliance deadline for capabilities.

The deadline for compliance with requirements for the capability for Phase II smart inverter functions was set when the SunSpec Alliance issued a testing protocol on May 22, 2018. The IOUs issued the first draft of their implementation plans for Phase II capabilities on October

26, 2018. With those developments, it became clear that D.16-06-052 and the ensuing Resolutions lacked sufficient direction to result in reasonable implementation of smart inverter requirements. The Commission should therefore consider this Petition to be timely.

### **3. Background**

Together with the California Energy Commission, the Commission created the Smart Inverter Working Group in early 2013. The SIWG has had a weekly standing call for much of the past five years with strong participation from utilities, inverter manufacturers, and other interested parties. It produced recommendations on Phase I autonomous functions in January 2014, Phase II communications standards in February 2015, and Phase III communications-enabled functions in March 2016.

On June 23, 2016, the Commission issued D.16-06-052, which concluded the previous Rule 21 proceeding, R.11-09-011. The decision incorporated the SIWG Phase II and Phase III recommendations by including the Working Group reports as appendices.

The IOUs issued the Phase II Advice Letters on December 20, 2016 adding a section on communications to Rule 21. The advice letters included a compliance date for Phase II smart inverter functions of nine months after the release of the SunSpec Alliance communication protocol certification test standard. Those advice letters were approved with Resolution E-4832 on April 6, 2017. The SunSpec Alliance released the test procedures for Phase II requirements on May 22, 2018, which established the compliance date as February 22, 2019.

The IOUs issued the Phase III Advice Letters on August 17 and August 18, 2017, adding and modifying language on Phase III functions. These advice letters aligned the compliance date for Phase III Functions 1, 5, 6, and 8 with the compliance date for Phase II. The advice letters were approved with Resolution E-4898 on April 26, 2018.

In August 2018, after a year-long hiatus the SIWG resumed meeting weekly to discuss implementation of the functions with a February 22, 2019 compliance date. There was severe disagreement among participants in those discussions, and it was a challenge for all parties to think through the complex facets of the discussions. On October 26, 2018, the IOUs circulated written implementation plans with more details about the process for complying with Phase II functions and Phase III Function 1 and Function 8 than were included in the Advice Letters.

CALSSA and some other parties considered those implementation plans to be unworkable and to be in conflict with Rule 21 and with the level of agreement that had been achieved. On November 19, 2018, CALSSA requested a six-month delay of the compliance date for Phase II and for Phase III Functions 1 and 8. The Commission granted the request on January 2, 2019. The letter granting the request is attached to this Petition as Attachment A.

### **Collaborative Process**

Before and after D.16-06-052, the Commission relied almost entirely on a collaborative process for implementing advanced inverter functionality rather than developing a record based on specific technical questions and including Commission judgment on those questions within that decision. There was no substantial discussion of the inverter functions in the body of the decision. The decision simply stated: “We encourage the parties and other interested stakeholders to continue to participate in the Working Group. Our Staff in the Energy Division will also continue to monitor emerging issues as improved inverters are deployed and communication protocols developed.”<sup>1</sup>

Conclusion of Law 21 of that decision states, “It is reasonable for the utilities to revise Rule 21 to reflect the technical requirements of the Smart Inverter Working Group’s

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<sup>1</sup> D.16-06-052, p. 41.

recommendations for Phase 2 communication protocols and Phase 3 additional advanced inverter functions, *following additional discussions to refine areas that require further consensus.*”

[emphasis added]

The decision directed utilities to file implementing advice letters based on areas of agreement. Ordering Paragraph 9 states:

Pacific Gas and Electric Company, Southern California Edison Company and San Diego Gas & Electric Company shall file proposed revisions to Tariff Rule 21 setting forth any *agreed-upon technical requirements*, testing and certification processes, and effective dates for Phase 2 communication protocols and Phase 3 additional advanced inverter functions in separate Tier 3 advice letters no later than six months from the effective date of this decision. [emphasis added]

Thus, the Commission relied on an advice letter process to bring together technical standards and regulatory requirements affecting nearly all distributed energy resources and anticipated that consensus would be achieved through collaboration. For the purely engineering aspects of standards development, the collaborative process mostly worked. For the policy aspects, in many ways it has not.

#### **4. IEEE 2030.5 Should Not Be Required at the Inverter Level**

The consensus that had been achieved for Phase II communications requirements as of D.16-06-052 was contained in the February 2015 SIWG recommendations. The Working Group recommended:

- The Smart Energy Profile 2.0 (SEP 2) as developed in the Institute of Electrical and Electronic Engineers (IEEE) 2030.5 standard should be the default communications protocol for communications with the utility.<sup>2</sup>

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<sup>2</sup> Smart Inverter Working Group, “Recommendations for Utility Communications with Distributed Energy Resources (DER) Systems with Smart Inverters,” p. 5.



- Distributed energy resources should have the option of communicating with utilities directly from an inverter or inverter control unit, from an energy management system, or through an aggregator.<sup>3</sup>
- There should be a single, consensus-based implementation guide that includes the relevant compliance mechanisms.<sup>4</sup>

On the last point, the SIWG recommendations state:

The SIWG recommends that the following topics are included in a single “California IEEE 2030.5 Implementation Guide” that has been agreed to and will be maintained by the utilities:

1. Date and version of the California IEEE 2030.5 Implementation Guide
2. The default data schemas for the data exchange requirements defined in the “DER Data Exchange Requirements” document.
3. Any specific configuration requirements for individual DER systems, facility energy management systems, and/or aggregators
4. Any additions or modifications to the minimal data exchange requirements that may be required for different types of implementations.
5. The default IEEE 2030.5 profile, including:
  - a. An interpretation of all data elements and objects
  - b. IEEE 2030.5 services for retrieving data, setting data values, and notifications
  - c. IEEE 2030.5 services for updating Groups of DERs
  - d. IEEE 2030.5 cyber security technologies and procedures
  - e. IEEE 2030.5 optional fields, values and commands such that they do not conflict with the base interoperability standard.
6. References to other documents as necessary for details on compliance or as useful as guidelines
7. Testing and certification requirements with references to facilities certified for performing such testing, such as the IEEE 2030.5 CSEP–Testing Certification Program and the SunSpec Alliance on ModBus Gateway to IEEE 2030.5
8. Identification of additional abstract IEC 61850 information model objects

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<sup>3</sup> Smart Inverter Working Group, “Recommendations for Utility Communications with Distributed Energy Resources (DER) Systems with Smart Inverters,” p. 6.

<sup>4</sup> Smart Inverter Working Group, “Recommendations for Utility Communications with Distributed Energy Resources (DER) Systems with Smart Inverters,” p. 7.

which could be translated to IEEE 2030.5 for additional functions.<sup>5</sup>

It is essential to recognize that Item 7 on the list above contains two elements related to testing and certification: IEEE 2030.5 for communication with the utility and SunSpec Modbus for communications between the resource and the device or entity communicating with the utility.

In addition, the SIWG recommendations stated:

At a minimum the following issues are recommended to be left up to “industry”, vendor, and/or general market decisions, although many additional issues are expected to be industry decisions:

1. The development of “gateways” that translate from other protocols to the utility communication protocols
2. The communication technologies used by the DER system between its communication module and the “gateway” to the utility
3. The communications media used between the “gateways” and the utility, so long as it does not pose a performance or security issue for the utility
4. Any other issues not covered in Rule 21 or the Utility Generation Interconnection Handbook<sup>6</sup>

Hence, it has long been clear that many DER providers did not intend to comply with communications requirements by incorporating IEEE 2030.5 capability into inverters but by using a different communications protocol in inverters that can be used in combination with a link to the utilities that is compliant with IEEE 2030.5.

The term “gateway” is sometimes used loosely but it is an important concept. In computing it describes a generic behavior of translating one protocol to another and does not denote a specific type of physical device or cloud-based service. Rule 21 includes provisions for “aggregators” and “energy management systems” as two types of gateways. The terms used in

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<sup>5</sup> Smart Inverter Working Group, “Recommendations for Utility Communications with Distributed Energy Resources (DER) Systems with Smart Inverters,” pp. 8-9.

<sup>6</sup> Smart Inverter Working Group, “Recommendations for Utility Communications with Distributed Energy Resources (DER) Systems with Smart Inverters,” p. 10.

the CSIP or IEEE 1547 may be different, but the concept of a gateway is consistent. In implementing smart inverter communications requirements, it is essential that Rule 21 treat the two sides of a gateway separately.

Rule 21 also uses the term “inverter control” in Section Hh.5. This can also be referred to as a site controller, system controller, or plant controller. One function of an inverter control unit is to combine the actions and communications of multiple inverters at a site as if the site had only one inverter. This unit can also contain the functionality of a gateway in addition to combining inverter inputs and outputs, in which case it is both the DER interface and the gateway. In this Petition we refer to the inverter control unit as the DER interface only, consistent with our interpretation of how it is used in Rule 21.

In March 2018, the Common Smart Inverter Profile Working Group issued *Common Smart Inverter Profile: IEEE 2030.5 Implementation Guide for Smart Inverters* (CSIP). It specifies details for application of IEEE 2030.5 to communications between a gateway and a utility. It does not specify details for communications between a DER and a gateway. Communications between the gateway and the DER was specifically stated to be out of scope. Thus, the CSIP does not fulfill the recommendation of the SIWG for a single implementation guide that includes testing for both sides of a communicating gateway.

### **Problem with SDG&E Implementation Plan**

SDG&E’s implementation plan states, “Phase II Communication Capability (Section Hh.5a.i): Inverter, EMS or ICU must be type tested by a NRTL to communicate to Smart Inverters per the SunSpec CSIP Test procedure to be certified.”<sup>7</sup> Because the CSIP Test Procedures are entirely about conformance to IEEE 2030.5, this requires IEEE 2030.5 at the

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<sup>7</sup> SDG&E implementation plan, p. 7.

inverter level. That outcome also results from the plan's discussion of Functions 1, 5 and 6. The plan states, "Incorporate these functions within the inverter and work with a NRTL to receive certification that the inverter meets UL 1741-SA (function 5 and 6) and SunSpec CSIP (function 1)."<sup>8</sup> "SunSpec CSIP (function 1)" does not test that an inverter performs Function 1. Rather, it tests that a Function 1 command is communicated consistent with IEEE 2030.5. Requiring the inverter to pass this test requires inverters to conform to IEEE 2030.5, which is inconsistent with the availability of the three communications options specified in Rule 21 Section Hh.5.

**Recommendation:** The Commission should modify Resolution E-4832 to order SDG&E not to require IEEE 2030.5 conformance in inverters.

## **5. Undefined Utility Field Testing Should Not Be Required**

The Commission relied on the SunSpec Alliance to develop the test to demonstrate compliance with the smart inverter communications requirements when it tied the compliance deadline to release of a SunSpec Alliance test standard. As PG&E Advice Letter 5129-E states, "In a parallel effort, SunSpec Alliance or another national organization is developing a national standard that will become the basis for testing and certifying Smart Inverter communication."<sup>9</sup> On May 22, 2018, the SunSpec Alliance released the CSIP Conformance Test Procedures. The Test Procedures cover communication with the utilities using IEEE 2030.5 but do not cover communications at the inverter level except in cases where the inverter will communicate directly with utilities. For facilities that select the options in Rule 21 to communicate with utilities via a gateway such as an energy management system or an aggregator, the test procedure only ensures that the communication between the gateway and the utility is consistent with utility communications standards and practice. It does not address inverter communication with

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<sup>8</sup> SDG&E implementation plan, p. 3.

<sup>9</sup> PG&E Advice 5129-E, p. 3.

gateways or inverter performance of functions.

In its October 2018 implementation plan, SDG&E states, “SDG&E and aggregator conduct end-to-end testing with SDG&E sending and receiving commands via IEEE 2030.5 protocol to demonstrate Phase 2 and 3 compliance.”<sup>10</sup> A one-sentence test procedure stated in a utility document that appears to have been hurriedly drafted bears no resemblance to the consensus-based testing protocols that are painstakingly developed by a diverse set of experts. Also, the CEC Approved Equipment List contains 548 inverter models that have been certified to the latest mandatory standard.<sup>11</sup> The IOUs have not demonstrated that they can handle that volume of testing.

**Recommendation:** The Commission should modify Resolution E-4832 to make clear that utilities cannot require their own brand of testing beyond the commissioning testing for large systems that is already specified in Rule 21 Section L.5. For product type testing, CALSSA recommends the compatibility testing described in the following section.

#### **6. Compatibility Testing Should Satisfy Compliance with Phase II Without Active Aggregator Agreements or Installed Gateway Devices**

For *capabilities*, Rule 21 Section Hh.5 requires communications capabilities as of a certain date. For *operations*, to date there are no requirements to operate with Phase II communications. In R.17-07-007, the Smart Inverter Working Group and the Rule 21 Working Group are jointly considering the following item:

What should be the operational requirements of smart inverters? What rules and procedures should the Commission adopt for adjusting smart inverter functions via communication controls?

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<sup>10</sup> SDG&E Implementation Plan, p. 5.

<sup>11</sup> The latest mandatory standard is UL 1741 Supplement A with Reactive Power Priority. The list is available at <https://www.gosolarcalifornia.ca.gov/equipment>.

Initial presentations by the IOUs suggest that they do not anticipate communications to be actively used until 2022 or later. DER providers are likely to recommend use cases to be implemented sooner, but those use cases would be voluntary. A customer may voluntarily use communications in order to interconnect a DER that is larger than would otherwise be approved or in order to participate in a tariff or program that will yield financial benefit. A decision on these questions is not expected until late 2019.<sup>12</sup>

### **Clarification of Capability**

As noted above, most DER providers and component manufacturers plan to meet communications requirements through gateways separate from inverters or inverter control units. Because operational requirements do not exist, it is not reasonable to require all customers to enter into contracts with aggregators or to invest in energy management devices that are not used today and may be used in the future only by some customers. For small systems, it is not reasonable to require all solar customers to have an active Internet connection that they may not otherwise use. Inverter manufacturers should verify that their equipment works with gateways, but customers should not be forced to make investments they may never end up using. Interoperability of installed equipment is the key, not installation of extra equipment for a potential future purpose.

The requirements are smart inverter requirements. They should be applied to inverters. Hundreds of customers per day are installing inverters, and the Commission should ensure that all of those inverters have a design that has been shown to be compatible with a gateway.

### **Test Procedure**

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<sup>12</sup> The November 16, 2018 “Assigned Commissioner’s Amended Scoping Memo and Joint Administrative Law Judge Ruling” established a schedule in which the record for this item would be complete on August 12, 2019.

To test a gateway for conformance to IEEE 2030.5, the testing lab tests communications between a server simulating a utility and the gateway without regard to what is connected on the far end of the gateway. However, the entity getting tested can connect a specific inverter model to the gateway. In that case, the testing lab can note the inverter model in the test results or a letter associated with the test results. Conformance with the standard is tested up to the gateway, but it is noted that a specific inverter model was connected to the gateway during testing.

For inverters that are not certified to IEEE 2030.5 at the level of the inverter or the inverter control unit, CALSSA recommends that the Commission require each inverter model or family of models to undergo compatibility testing as part of IEEE 2030.5 conformance testing of a gateway. In this testing, a nationally recognized testing laboratory (NRTL) would perform the following SunSpec CSIP test procedures on the aggregator or energy management system while it is connected to the inverter or inverter control unit:<sup>13</sup>

- Inverter Status (BASIC-028)
- Inverter Meter Reading (BASIC-029)
- Basic Inverter Control – Volt/Var (BASIC-006)
- Basic Inverter Control – Fixed Power Factor (BASIC-008)
- Basic Inverter Control – Volt-Watt (BASIC-011)

The NRTL should produce two reports. A test report would state that the gateway conformed to IEEE 2030.5. This can be certified by the SunSpec Alliance. A separate letter would state the inverter models that were connected to the gateway during testing. The CEC or another list maintaining entity can receive that letter, in addition to an affidavit from the

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<sup>13</sup> These tests are currently part of the CSIP Conformance Test Procedures. It must be verified that the commands do not include set points beyond the ranges of adjustability specified in Rule 21.

manufacturer, and use them as the basis for a list of compliant inverter models.<sup>14</sup>

The NRTL may perform a single verification for an inverter product family that uses the same communications tool and firmware. If a 5 kW inverter and a 10 kW inverter have different model numbers but the communications interface is the same, there is no need to test them separately for compatibility testing under IEEE 2030.5.

Once the CEC validates that an inverter model has passed an IEEE 2030.5 compatibility test, customers should be able to install that inverter model without also installing a gateway device or having an active contract with an aggregator. Some customers may choose to have active communications in anticipation of participating in future tariffs, especially customers installing larger systems, but they should be allowed to make the choice.

### **Problems with Implementation Plans and Rule 21**

The Phase II Advice Letters added Section Hh.5 to Rule 21. The section as proposed is not clear on the exact type of device or entity that must be capable of communications as a condition of interconnection. That ambiguity can be clarified as recommended herein.

Each of the IOU implementation plans state that they require an executed aggregator agreement for customers to interconnect after the compliance deadline for customers that choose the aggregator pathway. SCE states, “Execute an aggregator agreement as currently being drafted.”<sup>15</sup> PG&E and SDG&E state, “Rule 21 Aggregator to execute ‘Rule 21 Distributed Energy Resource Aggregation Agreement’ (Issue 6 in Rule 21 OIR).”<sup>16</sup> Even if a standard agreement were to be agreed upon by parties before the August 22, 2019 compliance deadline, it

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<sup>14</sup> The list of eligible inverters maintained by utilities may include models that are not on the CEC list, particularly for dedicated storage inverters that are approved by the utilities.

<sup>15</sup> SCE implementation plan, p. 6.

<sup>16</sup> PG&E implementation plan, p. 4; SDG&E implementation plan, p. 5.



would not be reasonable to require customers to enter into a contract with an aggregator when no communications are actually required. Aggregators will not offer contracts for free. It should be sufficient that the equipment a customer installs has been shown to be interoperable with an aggregator.

In addition, SDG&E has received approval for a change to Rule 21 that conditions the use of aggregators on an agreement that is not necessary at this stage. In SDG&E's version of Rule 21, Section Hh.5 states, "allowance of aggregator use under section Hh.5 is subject to Commission approval of applicable forms and agreement not currently developed." This was added in the implementing advice letter for Phase III, Advice Letter 3106-E, even though the section pertains to Phase II and the Phase II changes had already been approved in Advice Letter 3023-E.

**Recommendations:**

- The Commission should modify Resolution E-4832 to order the utilities to change Rule 21 Section Hh.5.i. to: "Inverter or inverter control unit shall be capable of communications with the Distribution Provider directly or through an aggregator or energy management system."
- The Commission should modify Resolution E-4832 to require the inverter type testing described in this section.
- The Commission should modify Resolution E-4898 to order SDG&E to conform its version of the first paragraph of Section Hh.5 of Rule 21 to the version of that paragraph in PG&E's tariff and SCE's tariff.

**7. Utilities Should Rely on Attestations for Phase III Function 1 and Function 8**

The CSIP Conformance Test Procedures do not test that electrical functionality is

properly executed at the inverter, even for inverters that communicate directly with the utility in accordance with IEEE 2030.5. They test that a command to perform a function is properly communicated, but do not test the ultimate inverter functions. No test exists for performance of Phase III Function 1 or Function 8 by the inverter or the inverter control unit.

A testing protocol for Function 1 at the inverter level is under development with the forthcoming IEEE 1547.1 standard. It is expected that a test will be agreed upon by consensus that will align with the functionality required by Rule 21.

Function 8 has two parts. One is the ability of inverters to change the set points of voltage functions in response to a command. That functionality will be tested in IEEE 1547.1. The other is the ability to store at least 24 commands. This can be done in the inverter itself or can be managed by an aggregator. In either case, the functionality is not difficult. Although no test currently exists, parties should be able to mutually agree on a verification mechanism on a reasonable timeframe. Until such an agreement, a manufacturer declaration should suffice.

### **Problems with Implementation Plans**

In the October 2018 implementation plans, SCE and PG&E require aggregators to be tested for the communications portions of Functions 1 and 8 as specified in the CSIP Test Procedures and to attest that the inverter or inverter control unit can perform the functions. SDG&E allows the same for Function 8. However, for Function 1 (as well as Functions 5 and 6), SDG&E requires: “Incorporate these functions within the inverter and work with a NRTL to receive certification that the inverter meets UL 1741-SA (function 5 and 6) and SunSpec CSIP (function 1).”<sup>17</sup> This requirement does not meet its intended purpose because “SunSpec CSIP (function 1)” does not test that the electrical functionality of Function 1 is properly executed at the inverter. Rather, it tests that a Function 1 command is communicated consistent with IEEE

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<sup>17</sup> SDG&E implementation plan, p. 3.

2030.5. A test of the capability of an inverter to perform Function 1 is under development in IEEE 1547.1, which is expected to be completed well before the end of 2019. Until then, an affidavit is the only compliance option.

**Recommendation:** The Commission should clarify in Resolution E-4898 that a manufacturer affidavit is sufficient to demonstrate compliance with the inverter functionality aspects of Function 1 and Function 8. This is a temporary solution until other standards are completed.

### **Failure to Create a Test Is Not a Major Setback**

At a November 17, 2016 workshop, the Commission pushed parties toward consensus on deadlines. CALSSA believes the extent to which consensus was actually achieved at that workshop was later overstated, but one result was the timeline in Resolution E-4898 in May 2018. That timeline included effective dates for Functions 1 and 8 of “9 months following SunSpec Alliance Communications Protocol Certification Test Standard.”<sup>18</sup> Two months prior to adoption of that resolution, the current version of the CSIP was released. As noted above, that document specifically excluded inverter functionality from the scope, so it should have been evident to all parties that the test standard based on the CSIP would not include inverter functionality. Unfortunately, the disconnect did not come into focus for parties until the test protocol was released.

CALSSA supports maintaining August 22, 2019 as the effective date for generating facilities to include Functions 1 and 8 if the Commission can respond to this Petition quickly and does not require new testing beyond what is recommended herein. Manufacturers of inverters or site controllers should be required to incorporate the functionality and ensure that it works

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<sup>18</sup> Resolution E-4898, Table 2, pp. 39-40.

according to their internal testing and quality control. However, CALSSA does not support creating a new test before August. Creating a test protocol requires thinking through the potential for unusual scenarios to produce different results and to carefully define what constitutes a pass and what constitutes a fail. If stakeholders were to attempt to create a new test before August, the risk would be high that agreement on a detailed testing protocol would not be achieved by the deadline, or that a protocol would be proposed that does not have consensus and manufacturers would not have sufficient time to respond. The uncertainty around needing to achieve certification on a tight timeline according to a test that does not exist would be unnecessarily disruptive.

The March 2016 SIWG Phase III recommendations included “Discussion Issues that have been raised and need further resolution *before these requirements could be included in Rule 21.*” [emphasis added] Those issues include:

- Function 1: “When and under what conditions will utilities require communications either during or after the interconnection process, given the unknown future grid issues and since there may be financial implications? Should utilities identify what communications are required during the interconnection process or can that decision also be made later? This data could also be used in future DRPs to determine locational and functional benefits.”<sup>19</sup>
- Function 1: “While not within the scope of these recommendations, market and compensation mechanisms will need to be developed for providing DER data to the

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<sup>19</sup> “SIWG Phase 3 DER Functions: Recommendations to the CPUC for Rule 21, Phase 3 Function Key Requirements, and Additional Discussion Issues,” p. 3.

utilities.”<sup>20</sup>

- Function 8: “Schedules have not been discussed in detail and need more in depth definitions of what they may or may not be required to do.”<sup>21</sup>

Hence, SIWG participants developed technical specifications for standards with the understanding that conditions for the use of the functions and compensation mechanisms would be developed before the requirements were included in Rule 21. That did not happen.

Functions 1 and 8 are not critical for safety and reliability. As solar adoption grows, there will be an increasing need for Function 1 to give utilities better visibility into conditions on the distribution system. However, it is telling that in the Rule 21 Working Group the utilities have not proposed any requirements for data reporting using smart inverter functionality, despite a clear invitation to do so. Utilities will have a big job building out their systems to be able to operate their end of Function 1 at scale, and they do not appear poised to take that step.

For Function 8, utilities spoke generally about demand response programs as a potential use of the functions at the time the technical specifications were being developed by the SIWG. There may also be use cases allowing customers to install larger systems while staying within existing grid hosting capacity, as well as compensation for voltage support from DERs as a non-wires alternative to traditional voltage regulating devices. All of these use cases are voluntary. CALSSA is highly interested in moving toward a more dynamic grid where customer-sited resources are more actively included in grid operations, but we also recognize that if verification of the scheduling capability is less than perfect over the next two years there is no harm done. We would rather avoid disruption to the market when it is most likely that inverter manufacturers

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<sup>20</sup> “SIWG Phase 3 DER Functions: Recommendations to the CPUC for Rule 21, Phase 3 Function Key Requirements, and Additional Discussion Issues,” p. 4.

<sup>21</sup> “SIWG Phase 3 DER Functions: Recommendations to the CPUC for Rule 21, Phase 3 Function Key Requirements, and Additional Discussion Issues,” p. 11.

are perfectly capable of ensuring this function works on their own. We urge the Commission to direct the IOUs to accept a manufacturer attestation for compliance with Phase III Function 1 and Function 8.

#### **8. Further Extension May Be Needed**

On January 2, 2019, the Commission extended the deadline for compliance with Phase II functions and Phase III Functions 1 and 8 from February 22, 2019 to August 22, 2019. It is CALSSA's hope that parties are able to come to reasonable agreement in response to this Petition and the Commission is able to issue a decision in time for any additional testing and certification that may be required before the current deadline. However, if it is difficult and time-consuming for the Commission to work through disagreements, the Commission may need to consider another extension to allow market participants enough time to demonstrate compliance before customers are required to use equipment with updated certifications as a condition for interconnection.

One additional issue related to the compliance date is that resubmittal of an interconnection application for a system that has already been installed should not reset the submittal date for purposes of smart inverter compliance. It is rare that a resubmittal is required by the utility significantly later than the installation date, but in cases where this happens the customer can be caught in a situation where the rules require inverters to be removed and another inverter model installed. The customer expense of such an equipment change does not justify the incremental functionality.

#### **9. Recommended Changes to Rule 21**

CALSSA appreciates that the Commission has encouraged a consensus-based process in the implementation of smart inverter capabilities. That process has yielded many positive results. However, there are disputed issues that the Commission needs to resolve. In light of the

problems with the October 2018 implementation plans, it is now apparent that the Phase II advice letters include provisions that are inconsistent with agreed-upon technical requirements. The Commission should modify the Resolutions to correct those provisions.

CALSSA recommends that an inverter be available for interconnection in compliance with the requirements for Phase II communications capability if any of the following conditions has been met.

- The inverter is certified to IEEE 2030.5.
- An energy management system has been certified to IEEE 2030.5 in combination with the inverter model.
- An aggregator has been certified to IEEE 2030.5 in combination with the inverter model.

**Recommendation:** The practical outcome described above can be achieved with modest changes to the Rule 21 communication requirements. Rather than approving the IOU advice letters as submitted, Resolution E-4832 should be modified to direct utilities to file amended advice letters that make the following changes to Rule 21 Section Hh.5.<sup>22</sup>

The communication protocol requirements included in this Hh.5 shall become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after August 22, 2019 ~~the later of (a) March 1, 2018 or (b) nine months after the release of the SunSpec Alliance communication protocol certification test standard or the release of another industry-recognized communication protocol certification test standard.~~ Until such date, this subsection may be used in all or in part by inverter-based technologies by mutual agreement of the Distribution Provider and the Applicant. ~~The e~~Communications requirements herein with the Distribution Provider shall be between (i) the Distribution Provider and the individual Generating Facility's

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<sup>22</sup> These changes are based on SCE's version of Rule 21. Section Hh.5 of Rule 21 for PG&E and SDG&E should be harmonized with this modified language.

inverter control or energy management system; (ii) the Distribution Provider and communication to the Generating Facility through an aggregator not co-located or part of the Generating Facility; or (iii) other communication options as mutually agreed to by Applicant and Distribution Provider.

a. Generating Facilities utilizing inverter-based technologies must adhere to all of the following communication protocol requirements ~~for communication between Distribution Provider and the communication option selected under section Hh.5.~~ This Rule does not specify the communication between the selected communication option and Smart Inverter but performance will be enforced by this Rule:

- i. Inverter or inverter control unit shall be capable of communications with the Distribution Provider directly or through an aggregator or energy management system.
- ii. Software shall be updateable via communications remotely;
- iii. The transport level protocol for communication with the Distribution Provider shall be TCP/IP; and,
- iv. The default application-level protocol for communication with the Distribution Provider shall be IEEE 2030.5 (i.e., Smart Energy Profile 2.0 (SEP 2)) as defined in the California IEEE 2030.5 Implementation Guide, but other application-level protocols may be used by mutual agreement of the parties including IEEE 1815/DNP3 for SCADA real-time monitoring and control and IEC 61850.

This language would clarify that a system could be installed with an inverter that is capable of communicating with a gateway that is certified to IEEE 2030.5, and that if the facility communicates with the utility it has to do so in conformance with IEEE 2030.5. The language does not require a customer to be under contract with an aggregator or have an installed EMS at this time.

To implement the changes to Rule 21 recommended above, this Petition recommends the following steps.

- A. IOUs should include implementation plans that have been vetted with the SIWG in amendments to the Phase II Advice Letters and the Phase III Advice Letters.



- B. Inverter models that do not conform individually to IEEE 2030.5 must be used in combination with an aggregator or energy management system during IEEE 2030.5 conformance testing. The aggregator or EMS manufacturer attests that the inverter communicates with the server and can execute the commands. The NRTL does not witness those commands or see a report but states that the aggregator attested that they witnessed the execution of the commands during the test.
- C. California Energy Commission or another entity maintains a list of inverters that are certified to IEEE 2030.5 or have an affidavit of successful compatibility testing including validation from the NRTL.
- D. The IOUs draw from that list to populate the list of eligible inverters in their interconnection application portals. In addition to the CEC list, the IOU list contains dedicated storage inverters that have undergone all relevant testing but are not on the CEC list due to additional testing requirements that are specific to solar.
- E. Utilities cannot require additional testing with the exception of commissioning testing for large systems as currently specified in Rule 21 Section L.5.

## **5. Conclusion**

Parties put full faith in the CSIP as the governing document for Phase II compliance at the same time that the facility gateway was considered out of scope in the CSIP. Those two decisions put together constitute a failure to create an end-to-end test procedure. This became apparent upon consideration of the final implementation plans for smart inverter Phase II functionality.

CALSSA greatly appreciates that the Commission has granted the time to consider changes to Rule 21 to address this problem before mandatory compliance with communications

capabilities requirements takes effect. CALSSA believes that the delay and the rule changes will not result in any significantly reduced functionality of distributed energy resources. It is our understanding that all or nearly all inverters installed today are designed with communications capabilities that will be interoperable with gateways that can communicate with utilities under IEEE 2030.5 when operation is required by further rule changes or encouraged by tariffs and programs.

## DECLARATION OF FACTUAL ACCURACY

*Petition of the California Solar & Storage Association for Modification of Resolution E-4832 and Resolution E-4898* (Petition), submitted February 11, 2019, was prepared under my supervision. The facts contained in the Petition are true and correct to the best of my knowledge. Any opinions expressed in the Petition reflect my best professional judgment.

I understand this declaration is made under penalty of perjury.

/s/ Brad Heavner

Brad Heavner

Brad Heavner  
Policy Director  
California Solar & Storage Association  
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DATE: February 11, 2019

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**Attachment A**

**Commission Letter Extending Compliance Date**

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**PUBLIC UTILITIES COMMISSION**

505 VAN NESS AVENUE  
SAN FRANCISCO, CA 94102-3298



January 2, 2019

Erik Jacobson  
Director, Regulatory Relations  
Pacific Gas & Electric Company  
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P.O. Box 770000  
San Francisco, CA 94177

Gary A Stern  
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Clay Faber  
Director, Federal & CA Regulatory  
San Diego Gas & Electric  
8330 Century Park Court  
San Diego, CA 92123

**RE: Request of the California Solar & Storage Association for Extension of Time to  
Comply with Rule 21 Smart Inverter Communications Requirements**

Dear Mr. Jacobson, Mr. Stern, and Mr. Faber:

Under the authority provided for in the Commission's Rules of Practice and Procedure, Section 16.6, the compliance deadline for Smart Inverter Phase II communications requirements, pursuant to Resolution E-4832, OP 2 and 4, and for Phase III Functions 1 and 8, pursuant to Resolution E-4898, OP 2.a, is extended to August 22, 2019.

This deadline extension letter is in response to the letter of November 19, 2018 from the California Solar & Storage Association (CALSSA). CALSSA requested a six-month extension of the deadline to comply with the Smart Inverter Phase II communications requirements ordered in Resolution E-4832 and an equivalent delay in the deadline for compliance with Phase III Functions 1 and 8, as established by Resolution E-4898 (the "deadline extension request" or "CALSSA request"). This request would extend the deadline from February 22, 2019 to August 22, 2019.

CALSSA served its request on the service list of Rulemaking (R.) 11-09-011 and of R.17-07-007. Southern California Edison and Pacific Gas & Electric responded to the CALSSA request affirming their non-opposition to the deadline extension request.

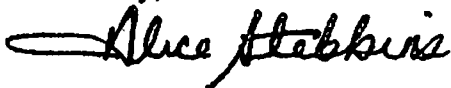
Due to the complex technical and procedural nature of the rollout of Rule 21 smart inverter capabilities, the complete background and discussion of the CALSSA request have been appended to this letter; see Appendix A.

We find that the extension requested by CALSSA is necessary. Additional time will provide both industry and the utilities more opportunity to smoothly roll of this rule change.

This deadline extension request applies only to the Smart Inverter Phase II communications requirements and to Functions 1 and 8 of the Smart Inverter Phase III requirements. It does not affect Smart Inverter Phase III Functions 5 or 6, which, pursuant to Resolution E-4898, OP 2.a, will be required for all inverter-based generating facilities as of February 22, 2019.

In conclusion, the compliance deadline for Smart Inverter Phase II communications requirements, pursuant to Resolution E-4832, OP 2 and 4, and for Phase III Functions 1 and 8, pursuant to Resolution E-4898, OP 2.a, is extended to August 22, 2019.

Sincerely,

A handwritten signature in black ink, appearing to read "Alice Stebbins", with a stylized flourish at the end.

Alice Stebbins  
Executive Director

cc: Brad Heavner, Policy Director, California Solar & Storage Association  
Service Lists of R.17-07-007 and R.11-09-011  
Kelly Hymes, Administrative Law Judge  
Michael Picker, Commissioner  
Forest Kaser, Advisor, Office of President Michael Picker  
Geoffrey Dryvynsyde, Assistant Chief Counsel  
Elizabeth Dorman, Principal Counsel

**APPENDIX A: Background and Discussion of the California Solar & Storage Association's (CALSSA) Request for Extension of Time to Comply with Smart Inverter Phase II Communications Requirements and Phase III Functions 1 and 8**

The California Public Utilities Commission (Commission) initiated Rulemaking (R.) 11-09-011 on September 22, 2011 to review and, if necessary, revise the rules and regulations governing the interconnection of generation and storage facilities to the electric distribution systems of the California investor-owned utilities (IOUs). In early 2013, the Smart Inverter Working Group was formed by parties of R.11-09-011 to develop proposals to take advantage of the new, rapidly advancing technical capabilities of inverters. The Smart Inverter Working Group (SIWG) submitted recommendations for Smart Inverter Phase II communications requirements in February 2015 and for Smart Inverter Phase III advanced functions in March 2016.

In June 2016, the Commission incorporated those recommendations into D.16-06-052, which directed the IOUs to file implementing advice letters within six months.

On December 20, 2016, the IOUs proposed Rule 21 revisions to incorporate the Phase II recommendations with a deadline of “nine months after the release of the SunSpec Alliance communication protocol certification test standard or the release of another industry-recognized communication protocol certification test standard.” Resolution E-4832 approved these revisions.

In August 2017, the IOUs proposed Rule 21 revisions to incorporate the Phase III recommendations. Resolution E-4898 approved the proposed revisions and adopted a deadline of the “[l]ater of March 1, 2018 or 9 months after the release of SunSpec Alliance Approved Test Procedure (or another industry-recognized protocol standard).”

The SunSpec Alliance released its Common Smart Inverter Profile (CSIP) on May 22, 2018, which established February 22, 2019 as the compliance date for generating facilities to have the functions described above.

Following the release of the CSIP, the SIWG recognized gaps in the certification regime. For example, while the Rule 21 tariff allows for communications between a generating facility and a utility to be mediated through an aggregator or energy management system (EMS), the CSIP procedures do not provide for end-to-end testing and consider communications between a generating facility and an aggregator or EMS to be out of scope. In August 2018, the SIWG began weekly meetings to address these implementation issues. On October 26, 2018, at the request of the Commission's Energy Division Staff and the parties of the SIWG, the IOUs released implementation plans describing their approaches to meeting the February 22 deadline (“implementation plans”). Subsequent discussion of the implementation plans indicated to Energy Division Staff that the plans needed more work to address the implementation challenges associated with both the deadline and other unforeseeable practical issues.

Given the need to continue discussions and seek greater clarity on how to proceed, the California Solar & Storage Association (CALSSA) determined that a deadline extension would be

beneficial to its members who construct generating facilities. On November 19, 2018, CALSSA requested a six-month extension of the deadline to comply with the Smart Inverter Phase II communications requirements ordered in Resolution E-4832 and an equivalent delay in the deadlines for compliance with Phase III Functions 1 and 8 contained in Resolution E-4898. CALSSA did not request a delay of other deadlines in Resolution E-4898.

On December 6, 2018 and December 10, 2018, respectively, Southern California Edison (SCE) and Pacific Gas & Electric (PG&E) noticed the service lists for R.11-09-011 and R.17-07-007 of their non-opposition to the CALSSA extension request. San Diego Gas & Electric (SDG&E) staff stated in a R.17-07-007 working group meeting on December 12, 2018 that SDG&E also intended to notice the service lists of their non-opposition.

In the same working group meeting, CALSSA stated an intention to submit a Proposal for Modification (PFM) of Resolutions E-4832 and E-4898. According to CALSSA's verbal statement, it plans to request that the Commission address specific implementation parameters of the Phase II and III functions under discussion in the CALSSA deadline extension request.

The deadline extension is necessary due to a variety of circumstances. First, the implementation of smart inverter communications requirements was unexpectedly complicated. While the SunSpec CSIP was expected to fulfill the testing and certification needs of industry and of the utilities, it left significant gaps. Moreover, no government agency currently oversees the CSIP or vets testing labs to carry out the test procedures specified therein. These issues were compounded by the late release of the IOUs' implementation plans, which were provided to equipment manufacturers and developers of generating facilities on October 26, 2018—less than four months before the existing deadline. While these implementation plans were intended to provide clarity on the roll out of this new set of requirements, they generated additional uncertainty and controversy.

The extension will provide equipment manufacturers and developers of generating facilities with additional time to prepare for the forthcoming requirements. Hence, Energy Division staff find it appropriate to grant a six-month extension. As such, the deadline for compliance with the Smart Inverter Phase II communications requirements and with Phase III Functions 1 and 8 is extended to October 22, 2019.

This deadline extension applies only to the Smart Inverter Phase II communications requirements and to Functions 1 and 8 of the Smart Inverter Phase III requirements. It does not affect Smart Inverter Phase III Functions 5 or 6, which, pursuant to Resolution E-4898, OP 2.a, will be required for all inverter-based generating facilities as of February 22, 2019.



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**Attachment B**

**SDG&E Implementation Plan**

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# SDG&E's Smart Inverter Phase II and Phase III (Functions 1, 5, 6, 8) Implementation

## Background

Resolutions [E-4832](#) and [E-4898](#) respectively issued on April 6, 2017 and April 26, 2018, established effective dates for smart inverter Phase 2 communications protocols and Phase 3 advanced inverter functions.

On July 11, 2018, Edward Randolph of the CPUC's Energy Division sent a letter to Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE) and San Diego Gas & Electric Company (SDG&E), titled "Clarification of Deadlines for Adoption of Smart Inverters Phase 2 Requirements and Functions 1, 5, 6 and 8 of Phase 3."

The letter provides clarification of deadlines based on SunSpec Alliance's approval of the SunSpec Common Start Inverter Profile (CSIP) Conformance Test Procedures on May 22, 2018. The approval serves as the release of the SunSpec Alliance communication protocol certification test standard under Resolutions E-4832 and E-4898. Hence Phase 2 (communication capability) and Function 1, 5, 6, and 8 of Phase 3 will become mandatory<sup>1</sup> for generating facilities utilizing inverter-based technologies for which an interconnection request is submitted on or after February 22, 2019. This deadline is not contingent on and will not be affected by the release of another industry-recognized communication protocol certification test standard.

For reference:

Function	Function Name
1	Monitor Key DER Data
5	Frequency Watt Mode (mandatory activation)
6	Volt Watt Mode (mandatory activation)
8	Scheduling Power Values and Modes

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<sup>11</sup> Mandatory in this context means that inverters installed on/after February 22, 2019 are required to be capable of providing Function 1 and Function 8 requirements, and inverters installed on/after February 22, 2019 are required to have Function 5 and Function 6 activated.

# SDG&E's Smart Inverter Phase II and Phase III (Functions 1, 5, 6, 8) Implementation

## Rule 21 Options

Electric Rule 21 has also been updated to reflect resolution requirements shown in the appendix

Rule 21 **Phase II requirement** for inverter based Generating Facilities shall be between:

- 1) Inverter or Inverter Control Unit; or
- 2) Energy Management System; or
- 3) Aggregator; or
- 4) Other as mutually agreed

Rule 21 **Phase III Function 1, 5, and 6 requirements** for inverter based Generating Facilities shall be at the **Inverter or Inverter Control Unit for a micro-inverter system**

Rule 21 **Phase III Function 8 requirement** for inverter based Generating Facilities shall be between:

- 1) Inverter or Inverter Control Unit; or
- 2) Energy Management System; or
- 3) Aggregator; or
- 4) Other as mutually agreed

# SDG&E's Smart Inverter Phase II and Phase III (Functions 1, 5, 6, 8) Implementation

## To populate a list of approved devices/aggregators:

For a Generating Facility to be considered compliant with Rule 21 requirements, the following eligible equipment lists are needed to be selected in the application process. The following steps must be completed:

### Inverter Manufacturers or Inverter Control Unit (ICU) Manufacturers

- Function 1, 5, and 6
  - Incorporate these functions within the inverter and work with a NRTL to receive certification that the inverter meets UL 1741-SA (function 5 and 6) and SunSpec CSIP (function 1)
- Function 8
  - Incorporate this function within the inverter and work with a NRTL to receive certification that the inverter meets SunSpec CSIP (function 8)
- Phase II
  - Incorporate 2030.5 capability within the inverter and work with a NRTL to receive certification that the inverter meets SunSpec CSIP (2030.5)
- While the NRTL is testing the functionality of the inverter and CSIP conformance, the NRTL communicates to the inverter via IEEE 2030.5 protocol. The NRTL would send a command to read the DER device, then send a schedule, wait a period of time and then perform another read command. This allows a NRTL to certify and validate the inverter functionality and the capability of the inverter to be capable of communications via IEEE 2030.5.
- Send NRTL summary test reports and confirmation of certification to testing protocols to the CEC (pending confirmation from CEC)

An example of a list of approved Inverter or Inverter Control Units (Image shows EMS but should reflect Inverter or Inverter Control Unit):

Company Name	End-Device Type (Inverter/EMS/Inverter Control)	End-Device Manufacturer*	End-Device Model Number *	Date Listed	Date Tested	Notes
Green Power Company	EMS-A	Inverter	inverter 4.1.v1	9/26/2018	8/26/2018	XXX
Green Power Company	EMS-A	Inverter	inverter 4.1.v2	9/26/2018	8/26/2018	XXX
Green Power Company	EMS-A	Inverter	inverter 4.1.v3	9/26/2018	8/26/2018	XXX
Green Power Company	EMS-A	Inverter	inverter 4.1.v4	9/26/2018	8/26/2018	XXX
Green Power Company	EMS-A	Inverter	inverter 4.1.v5	9/26/2018	8/26/2018	XXX
Green Power Company	ICU- A	Inverter	inverter 4.1.v6	9/26/2018	8/26/2018	XXX
Green Power Company	ICU- A	Inverter	inverter 4.1.v7	9/26/2018	8/26/2018	XXX
Green Power Company	ICU- A	Inverter	inverter 4.1.v8	9/26/2018	8/26/2018	XXX
Green Power Company	ICU- A	Inverter	inverter 4.1.v9	9/26/2018	8/26/2018	XXX
Green Power Company	ICU- A	Inverter	inverter 4.1.v10	9/26/2018	8/26/2018	XXX

# SDG&E's Smart Inverter Phase II and Phase III (Functions 1, 5, 6, 8) Implementation

## Energy Management System Manufacturers

- Function 8
  - Incorporate this function and work with a NRTL to receive certification that the EMS meets SunSpec CSIP (function 8)
- Phase II
  - Incorporate 2030.5 capability and work with a NRTL to receive certification that the EMS meets SunSpec CSIP (2030.5)
  - While the NRTL is testing the functionality of the inverter and CSIP conformance, the NRTL communicates to the inverter via IEEE 2030.5 protocol. The NRTL would send a command to read the EMS device, then send a schedule, wait a period of time and then perform another read command. This allows a NRTL to certify and validate the inverter functionality and the capability of the EMS to be capable of communications via IEEE 2030.5.
- Send NRTL summary test reports and confirmation of certification to testing protocols to IOUs

An example of a list of approved Inverter Control Units or Energy Management Systems is shown below:

Company Name	End-Device Type (Inverter/EMS/Inverter Control)	End-Device Manufacturer*	End-Device Model Number *	Date Listed	Date Tested	Notes
Green Power Company	EMS-A	Inverter	inverter 4.1.v1	9/26/2018	8/26/2018	XXX
Green Power Company	EMS-A	Inverter	inverter 4.1.v2	9/26/2018	8/26/2018	XXX
Green Power Company	EMS-A	Inverter	inverter 4.1.v3	9/26/2018	8/26/2018	XXX
Green Power Company	EMS-A	Inverter	inverter 4.1.v4	9/26/2018	8/26/2018	XXX
Green Power Company	EMS-A	Inverter	inverter 4.1.v5	9/26/2018	8/26/2018	XXX
Green Power Company	ICU- A	Inverter	inverter 4.1.v6	9/26/2018	8/26/2018	XXX
Green Power Company	ICU- A	Inverter	inverter 4.1.v7	9/26/2018	8/26/2018	XXX
Green Power Company	ICU- A	Inverter	inverter 4.1.v8	9/26/2018	8/26/2018	XXX
Green Power Company	ICU- A	Inverter	inverter 4.1.v9	9/26/2018	8/26/2018	XXX
Green Power Company	ICU- A	Inverter	inverter 4.1.v10	9/26/2018	8/26/2018	XXX

# SDG&E's Smart Inverter Phase II and Phase III (Functions 1, 5, 6, 8) Implementation

## Aggregators

- Function 8
  - Incorporate this function so that the Aggregator meets SunSpec CSIP (function 8)
- Phase II
  - Incorporate 2030.5 capability so that the Aggregator meets SunSpec CSIP (2030.5)

## Rule 21 Aggregator Conformance Process

- Rule 21 Aggregator to submit information to IOUs to be evaluated for the following but not limited to:
  - Phase II and Phase III capability and certification
  - Third Party Review
- SDG&E and aggregator conduct end-to-end testing with SDG&E sending and receiving commands via IEEE 2030.5 protocol to demonstrate Phase 2 and 3 compliance
  - As part of the requirements tests, SDGE would send a command to read the DER device, then send a schedule, wait a period of time and then perform another read command.
- Rule 21 Aggregator to execute "Rule 21 Distributed Energy Resource Aggregation Agreement" (Issue 6 in Rule 21 OIR)

An example of a list of approved aggregators is shown below:

Company Name	Aggregator Unique Identifier *	Date Listed	SunSpect Test Date	Notes
Green Power Company	Green Power 4512	9/26/2018	9/26/2018	XXX
Blue Power Company	Blue Power 6065	9/26/2018	9/26/2018	XXX
Orange Power Company	Orange Power 9550	9/26/2018	9/26/2018	XXX
Yellow Power Company	Yellow Power 4387	9/26/2018	9/26/2018	XXX

# SDG&E's Smart Inverter Phase II and Phase III (Functions 1, 5, 6, 8) Implementation

## DER Applications on/after Feb 22, 2019

For each DER application, they must select and indicate the following:

- Phase II – option 1-4 – indicate which option and the selected equipment
  1. Inverter or Inverter Control Unit; or
  2. Energy Management System; or
  3. Aggregator; or
  4. Other as mutually agreed
- Phase III Function 1, 5, and 6 – indicate model of inverter
  - Function 5 and 6 must be activated
  - To be indicated in Application and Interconnection Agreement
- Phase III Function 8 – option 1-4 – indicate which option and the selected equipment
  1. Inverter or Inverter Control Unit; or
  2. Energy Management System; or
  3. Aggregator; or
  4. Other as mutually agreed

For options that **do not** involve an aggregator, select a certified device in the interconnection process.

- This process will be very similar to the current interconnection process. Certified devices will move through the Fast Track review as a certified device and the certification and testing will be in accordance to Rule 21 Section L.2.a and L.5.d (Certified Equipment)

For options that **do** involve an aggregator, select an approved aggregator and which functions the aggregator will fulfill on behalf of DER (function 8, function 8 and 2030.5, or 2030.5 only)

- This process will be similar to the current interconnection process with a few key differences
  - The selected inverter or inverter control unit must be compliant with Phase 2 and 3 requirements
  - The aggregator must have completed the Rule 21 aggregator conformance process
  - The DER must demonstrate via commissioning testing that Rule 21 requirements are met in accordance to Rule 21 Section L.5.f (Verification of Settings)
    - For example, this involves verification that the “Smart Inverter responds by changing its mode of operation as commanded at the schedule start time with no unreasonable delay.”
    - The DER to execute the “Participating Generating Facility – Aggregation Agreement” (Issue 6 in Rule 21 OIR)

For application indicating different equipment options for Phase II and Phase III Function 8, SDG&E shall only provision one communication channel per Participating Generating Facility based on the Phase II communication selection. The integration of separate equipment needed for Phase III Function 8 is the responsibility of the applicant.

# **SDG&E's Smart Inverter Phase II and Phase III (Functions 1, 5, 6, 8) Implementation**

## **Additional Information on Phase II and Phase III Function 1 and 8**

### **Phase II Communication Capability (Section Hh.5a.i)**

- Inverter, EMS or ICU must be type tested by a NRTL to communicate to Smart Inverters per the SunSpec CSIP Test procedure to be certified
- Aggregator will be verified by the Aggregator Conformance Process

### **Phase III Function 8 Capability (Section Hh.6)**

- Provide evidence that Aggregator, EMS, ICU or Inverter can maintain a minimum of 24 scheduling events
- EMS, ICU or Aggregator demonstrate the ability to send commands according to the schedules to Smart Inverters
- Smart Inverters to demonstrate ability to function according to schedule

### **Phase III Function 1 Capability (Section Hh.7)**

- Demonstrate that Smart Inverter has the capability to send its required performance information to the EMS, ICU or Aggregator and to the Utility Server
- EMS, ICU or Aggregator must be certified using SunSpec Test Protocol to be able to send information to utility via 2030.5



# **SDG&E's Smart Inverter Phase II and Phase III (Functions 1, 5, 6, 8) Implementation**

## [Appendix: Rule 21 Excerpts from SDG&E's Electric Rule 21](#)

### **Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)**

#### **5. COMMUNICATION REQUIREMENTS**

- a. The communication protocol requirements included in this section Hh.5 shall become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted February 22, 2019, nine (9) months following the approval of the SunSpec Alliance Communication Protocol Certification Test Standard. Until such date, this subsection may be used in all or in part by inverter-based technologies by mutual agreement of the Distribution Provider and the Applicant. The communications requirements herein shall be between:
  - (i) the Distribution Provider and the individual Generating Facility's inverter control or energy management system;
  - (ii) the Distribution Provider and communication to the Generating Facility through an aggregator not co-located or part of the Generating Facility; or
  - (iii) other communication options as are mutually agreed to are by Applicant and the Distribution Provider.

### **Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)**

#### **5. COMMUNICATION REQUIREMENTS (Cont'd.)**

- b. Generating Facilities utilizing inverter-based technologies must adhere to all of the following communication protocol requirements for communications between Distribution Provider and communication option selected in section Hh. 5. This Rule does not specify the communication between the selected communication option and Smart Inverter but performance will be enforced by in compliance with this Rule:
  - (i) Shall be capable of communications;
  - (ii) Software shall be updateable via communications remotely;
  - (iii) The transport level protocol shall be TCP/IP; and,
  - (iv) The default application-level protocol shall be IEEE 2030.5 (i.e., Smart Energy Profile 2.0 (SEP 2)) as defined in the California IEEE 2030.5 Implementation Guide, but other application-level protocols may be used by mutual agreement of the parties including IEEE 1815/DNP3 for SCADA real-time monitoring and control and IEC 61850.

# **SDG&E's Smart Inverter Phase II and Phase III (Functions 1, 5, 6, 8) Implementation**

## **Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)**

### **5. COMMUNICATION REQUIREMENTS (Cont'd.)**

- c. Additional communication protocol requirements shall also apply to Generating Facilities utilizing inverter-based technologies as provided in the following documents:
  - (i) Distribution Provider Generation Interconnection Handbook, which shall include:
    - a) Details and guidelines for the implementation of communications with Generating Facilities utilizing inverter-based technologies;
    - b) Cybersecurity and privacy requirements (these may additionally or alternatively be included in the application-level protocol implementation guide); and,
    - c) Generic device communications registration management requirements, including how to register individual Generating Facilities, Generating Facilities with energy management systems, and aggregators (these requirements additionally or alternatively may be included in the application-level protocol implementation guide).
  - (ii) Application-Level Protocol Implementation Guide, which shall provide:
    - a) Communication requirements and implementation guidelines to ensure consistent interoperability of the Generating Facilities with all California investor-owned utilities under the Commission's jurisdiction.

# **SDG&E's Smart Inverter Phase II and Phase III (Functions 1, 5, 6, 8) Implementation**

## **Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)**

### **6. SCHEDULING CAPABILITY REQUIREMENTS**

- a. Generating Facilities which incorporate Smart Inverters shall incorporate scheduling capabilities with a minimum scheduling memory capability of at least 24 events. The capability for this requirement will be mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after February 22, 2019, nine (9) months following the approval of the SunSpec Alliance Communication Protocol Certification Test Standard.

The utilization of this function is permissible under mutual agreement between the utility and the generating facility before the effective date.

Each event is composed of modifications to each, selected group of, or all of the following Smart Inverter function.

- (i) Modifications to the voltage and reactive set-points of the Dynamic volt/var function.
- (ii) Modifications to the reactive power set-points for the fixed power factor function.
- (iii) Modifications to the voltage and watt-reduction level set-points for the volt/watt function.



# **SDG&E's Smart Inverter Phase II and Phase III (Functions 1, 5, 6, 8) Implementation**

## **Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)**

### **6. SCHEDULING CAPABILITY REQUIREMENTS (Cont'd.)**

- b. The Generating Facility's scheduling capability requirement herein shall be met by one or more of the following options.
  - (i) Scheduling capability requirements may be stored at the Generating Facility Energy Management System (GFEMS). The GFEMS shall communicate the necessary commands to the Smart Inverters within 10 minutes from when GFEMS received the scheduling information.
  - (ii) Scheduling capability requirements may be stored at the Smart Inverter Control Unit (SMCU) within the Generating Facility. The SMCU shall communicate necessary commands to the Smart Inverters within 10 minutes from when SMCU received the scheduling information.
  - (iii) Scheduling capability requirements may be stored at an aggregator not co-located within the Generating Facility. The aggregator shall communicate the necessary commands to the Smart Inverters within 15 minutes of the aggregator receiving the scheduling information.
  - (iv) Other options may be utilized by mutual agreement between the Applicant and Distribution Provider.
- c. The selected scheduling control system shall store the schedules and shall send operational commands to the Smart Inverters as required by the schedule received from the Distribution Provider. The Smart Inverter shall respond by changing its mode of operation as commanded at the schedule start time with no unreasonable delay.

Each scheduled mode of operation shall include and start-time and duration. The Smart Inverter should return to its default settings at the end of the duration time or shall enter a new operational mode as directed by the scheduling control system.

# **SDG&E's Smart Inverter Phase II and Phase III (Functions 1, 5, 6, 8) Implementation**

## **Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)**

### **7. MONITORING AND TELEMETRY REQUIREMENTS**

- a. The capability for this requirement will be mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after February 22, 2019, nine (9) months following the approval of the SunSpec Alliance Communication Protocol Certification Test Standard.

The utilization of this function is permissible under mutual agreement between the utility and the generating facility before the effective date.

Smart Inverter shall have the capability to communicate its performance information including:

- (i) Smart Inverter production or consumption of active power (Watts).
- (ii) Smart Inverter consumption or production of reactive power (VARs)
- (iii) Phase measured at the AC terminals of the Smart Inverter (Volts)
- (iv) Frequency measured at the AC terminals of the Smart Inverter (Hz)

# **SDG&E's Smart Inverter Phase II and Phase III (Functions 1, 5, 6, 8) Implementation**

## **Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)**

### **7. MONITORING AND TELEMETRY REQUIREMENTS (Cont'd.)**

- b. When the Generating Facility includes energy-storage with Smart Inverters, the following monitoring and telemetry capability are required:
  - (i) The Smart Inverter shall be capable of communicating the percentage of energy-storage capacity. Operational energy of the energy storage system is the amount energy which can be used to support the energy needs of the electric system including the energy needs for the load within the generating facility or the Distribution System.
- c. Operational State as In-Service or not In-service communication capability requirements. The Smart Inverter shall be capable of communicating when the Smart Inverter is capable of providing electric services as follows:
  - (i) In-Service state: An operational state which indicates that the Smart Inverter is connected to the electric system and operating as determined locally by the Generating Facility operator or by a scheduling control system as outlined in section Hh.6
  - (ii) Not In-Service state: An operating state which indicates that the Smart Inverter is not capable of connecting to the electric system and not capable of providing any type of electrical support as required locally or as commanded by a scheduling control system as outlined in section Hh.

# **SDG&E's Smart Inverter Phase II and Phase III (Functions 1, 5, 6, 8) Implementation**

## **Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)**

### **7. MONITORING AND TELEMETRY REQUIREMENTS (Cont'd.)**

- d. Monitoring and performance information should be communicated in aggregate at the Generating Facility as follows:
  - (i) When the Generating Facility includes only Smart Inverters: The production or consumption of active and reactive power shall be communicated as an aggregate of all Smart Inverters within the Generating Facility.
  - (ii) When a Generating Facility includes Smart Inverters and other technologies such as synchronous or induction generation systems, the Generating Facility should communicate the following:
    - a) The production or consumption of active and reactive power shall be communicated in aggregate of all Smart Inverters within the Generating Facility
    - b) The production or consumption of active and reactive power shall be communicated in aggregate of all the other technologies within the Generating Facility
  - (iii) When the Generating Facility with Smart Inverters includes one or multiple energy storage systems: The available operational energy should be communicated as an aggregate of all the energy storage systems.



# SDG&E's Smart Inverter Phase II and Phase III (Functions 1, 5, 6, 8) Implementation

## Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

### 8. CONTROL THROUGH COMMUNICATION CAPABILITIES

- a. The capability for these requirements will be mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after the earlier of the dates shown in the "Table of Phase 3 Effective Dates Pursuant to Resolution E-4898" in Section Hh.2.q.

The utilization of these functions is permissible under mutual agreement between the utility and the generating facility before the effective date.

Smart Inverters shall have the capabilities of accepting an operational controls through communications in accordance to the following:

- (i) Cease to energize control command. When the Smart Inverter receives a cease-to-energize command through communication it must enter into a cease-to-energize state of operation or shall initiate the opening of the DER switch referenced in the ECP in order to galvanically isolate the DER system from the Distribution System
- (ii) Return to service control command. When the Smart Inverter receives a return-to-service control command, the Smart Inverter may return to service operation as required by Generating Facility operator or as required by the scheduling control system as required by section H.6
- (iii) Limit Active Power command. When the Smart Inverter receives a command to limit its production of real power, the Smart Inverter shall reduce its real power production to the specified percent of real power capacity of the Smart Inverter or to a specified real power value.
- (iv) Set Active Power Level Mode Function. The capability for this requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted twelve (12) months after approval of a nationally recognized standard that includes the function.
- (v) Suspension of Active Power restriction. When the Smart Inverter receives a command to suspend the command for active power reduction, the Smart Inverter may return to normal operation as required by Generating Facility operator or as required by the scheduling control system as required by section H.6.



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**Attachment C**

**SCE Implementation Plan**

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# **Southern California Edison**

## **Smart Inverter Phase II and Phase III (Function 1, 5, 6, 8)**

### **Implementation**

#### Smart Inverter Functionality Requirements for Rule 21 Interconnection Applications Submitted on or after February 22, 2019

Pursuant to CPUC resolutions E-4832 and E-4898, as supplemented by a July 11, 2018 letter from the Director of CPUC's Energy Division, starting February 22, 2019, all applicants submitting interconnection requests under SCE's Rule 21 tariff will be required to comply with smart inverter Phase II and Phase III functionality as described below.

#### Background

Resolutions [E-4832](#) and [E-4898](#) respectively issued on April 6, 2017 and April 26, 2018, established effective dates for smart inverter Phase 2 communications protocols and Phase 3 advanced inverter functions.

On July 11, 2018, Edward Randolph, Director of the CPUC's Energy Division, sent a letter to Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE) and San Diego Gas & Electric Company (SDG&E), titled "Clarification of Deadlines for Adoption of Smart Inverters Phase 2 Requirements and Functions 1, 5, 6 and 8 of Phase 3."

The letter provides clarification of deadlines based on SunSpec Alliance's approval of the SunSpec Common Start Inverter Profile (CSIP) Conformance Test Procedures on May 22, 2018. The approval serves as the release of the SunSpec Alliance communication protocol certification test standard under Resolutions E-4832 and E-4898. Hence Phase 2 (communication capability) and Function 1, 5, 6, and 8 of Phase 3 will become mandatory for generating facilities utilizing inverter-based technologies for which an interconnection request is submitted on or after February 22, 2019.

For your reference:

Function	Function Name
1	Monitor Key DER Data
5	Frequency Watt Mode (mandatory activation)
6	Volt Watt Mode (mandatory activation)
8	Scheduling Power Values and Modes

## Rule 21 Options

Electric Rule 21 has also been updated to reflect resolution requirements shown in the appendix

Rule 21 **Phase II requirement** for inverter based Generating Facilities shall be between Distribution Provider and:

- 1) Inverter or Inverter Control Unit; or
- 2) Energy Management System; or
- 3) Aggregator; or
- 4) Other as mutually agreed

Rule 21 **Phase III Function 1, 5, and 6 requirements** for inverter based Generating Facilities shall be at the **Inverter**

Rule 21 **Phase III Function 8 requirement** for inverter based Generating Facilities shall at:

- 1) Inverter or Inverter Control Unit; or
- 2) Energy Management System; or
- 3) Aggregator; or
- 4) Other as mutually agreed

## Methods of compliance with phase II and Phase III

There will be three methods of complying as specified below:

Method A: Using certified inverter (Figure 1) and declaration that inverter performance meets the rule 21 section Hh requirements.

Method B: Using certified inverter, certified ICU/EMS (Figure 2), and declaration that inverter and ICU/EMS performance meets the rule 21 section Hh requirements.

Method C: Using certified inverter, certified aggregator (Figure 3), and declaration that inverter, ICU/EMS and aggregator and related communication systems performance meets the rule 21 section Hh requirements.

These methods are contingent on SCE's ability to update its interconnection portal (PCI).

### Method A: Inverter Used As Main Interface (Figure 1)

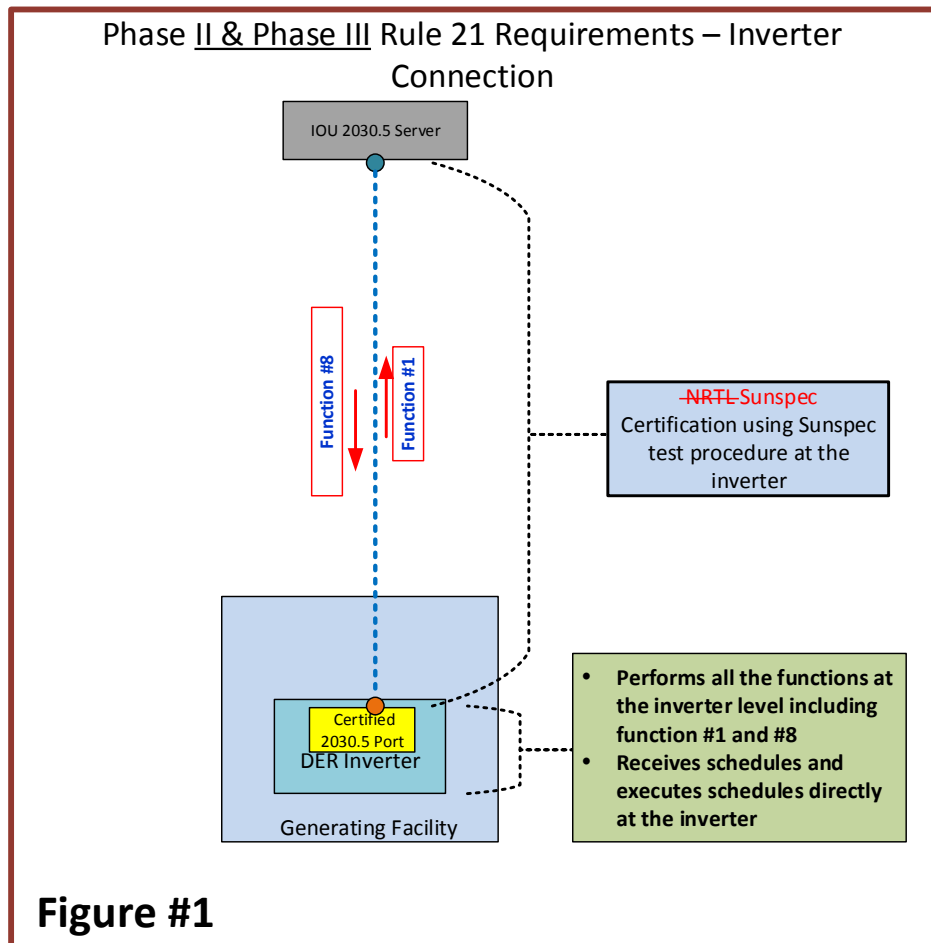
**Inverters will require to have the following:**

- a) NRTL certification using UL1741/1741SA(all Phase I Functions and Phase II Functions 5 and 6)

- b) ~~NRTL~~ **Sunspec** certification using the Sunspec Test Procedure requirements (Hh.5).  
Currently OSHA does not list CSIP conformance testing as one of the recognized testing standards which NRTLs can perform<sup>1</sup>.
- Functions 1, 8
- c) Memory to store 24 events (Hh.6)
- d) Declaration that inverters are able to perform phase III functions 1 and 8. For Function 1 that inverters are able to provide performance information to utility as required in Rule 21 Section Hh-7. For Function 8 the inverter is able to accept commands from utility and the inverter changes its performance parameters as directed by the utility as required in Section Hh-6. This Declaration will be a temporary measure while a national standard is developed or the revisions to IEEE1547.1 are approved

**Inverter Manufacturer/~~NRTL~~/Sunspec**

Provide ~~NRTL~~ **Sunspec** test summary reports and certification information to the CEC or utility (pending CEC plans to incorporate phase II and Phase III functions)



<sup>1</sup> <https://www.osha.gov/dts/otpc/nrtl/nrtllist.html>

## Method B: Inverter Control Unit (ICU)/Energy Management System (EMS) Used As Main Interface (Figure 2)

### **Inverters and ICU/EMS will require the following:**

#### **Inverters:**

- a) NRTL certification using UL1741/1741SA(all Phase I Functions and Phase II Functions 5 and 6)
- b) Declaration that inverters are be able to perform phase III functions 1 and 8. For Function 1 the inverters are able to provide performance information to ICU/EMS as required in Rule 21 section Hh-7. For Function 8 that the inverter is able to accept commands from ICU/EMS and the inverter changes its performance parameters as directed by the ICU/EMS as required by Hh-6. This declaration will be a temporary measure while a national standard is developed or the revisions to IEEE1547.1 are approved

#### **ICU/EMS:**

- a) ~~NRTL~~ Sunspec certification using the Sunspec Test Procedure (Hh.5). **Currently OSHA does not list CSIP conformance testing as one of the recognized testing standards which NRTLs can perform<sup>2</sup>.**

~~NRTL~~ Sunspec summary test reports and certification information SCE to create information as shown on table 1. This if information would be used in conjunction with the interconnection tool to continue the existing expeditious interconnection process for small NEM DERs

- b) (Declaration) Ability to receive and send information for related to functions 1 & 8 (Sunspec certification)
- c) (Declaration) Have the memory to store 24 events (Hh.6)
- d) (Declaration) Have the ability to communicate to inverters as required by rule 21 from ICU/EMS using DER owners' own protocol and communication systems

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<sup>2</sup> <https://www.osha.gov/dts/otpc/nrtl/nrtllist.html>

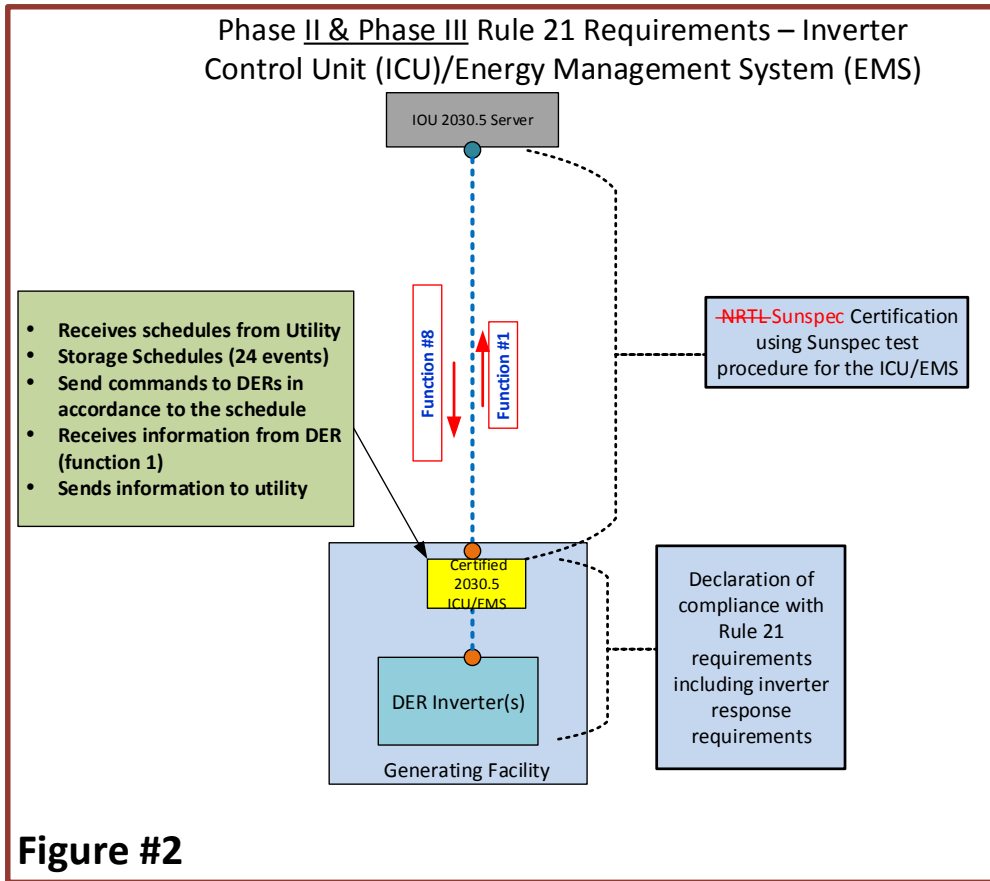


Table 1. SCE Listing of certified EMS and ICU

Company Name	EMS/ICU Unique Identifier*	Date Listed	Date Tested	Notes
Green Power Company	EMS-A	9/26/2018	8/26/2018	XXX
Green Power Company	EMS-A	9/26/2018	8/26/2018	XXX
Green Power Company	EMS-A	9/26/2018	8/26/2018	XXX
Green Power Company	EMS-A	9/26/2018	8/26/2018	XXX
Green Power Company	EMS-A	9/26/2018	8/26/2018	XXX
Green Power Company	ICU- A	9/26/2018	8/26/2018	XXX
Green Power Company	ICU- A	9/26/2018	8/26/2018	XXX
Green Power Company	ICU- A	9/26/2018	8/26/2018	XXX
Green Power Company	ICU- A	9/26/2018	8/26/2018	XXX
Green Power Company	ICU- A	9/26/2018	8/26/2018	XXX

\* This must be exactly what a DER customer would indicate in their applications

### Method C: Aggregators Used as Main Interface – Figure 3

Used for main interphase to utility will require the following:

**Inverters:**

- c) NRTL certification using UL1741/1741SA(all Phase I Functions and Phase II Functions 5 and 6)
- d) Declaration that inverters are be able to perform phase III functions 1 and 8. For Function 1 the inverters are able to provide performance information to aggregator as required in Rule 21 section Hh-7. For Function 8 that the inverter is able to accept commands from aggregator and the inverter changes its performance parameters as directed by the aggregator as required by Hh-6. This declaration will be a temporary measure while a national standard is developed or the revisions to IEEE1547.1 are approved

**Aggregator:**

- a) ~~NRTL~~ Sunspec certification using the Sunspec Test Procedure (Hh.5). **Currently OSHA does not list CSIP conformance testing as one of the recognized testing standards which NRTLs can perform<sup>3</sup>.**  
~~NRTL~~ Sunspec test reports and certification information SCE to create information as shown on table 2. This if information would be used in conjunction with the interconnection tool to continue the existing expeditious interconnection process for small NEM DERs
- a) (Declaration) Ability to receive and send information related to Functions 1 and 8
- b) (Declaration) Have the memory to store 24 events (Hh.6)
- c) (Declaration) Have the ability to communicate as required by rule 21 from aggregator to inverter using aggregator's own protocol and communication systems
- d) Execute an aggregator agreement as currently being developed

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<sup>3</sup> <https://www.osha.gov/dts/otpc/nrtl/nrtllist.html>

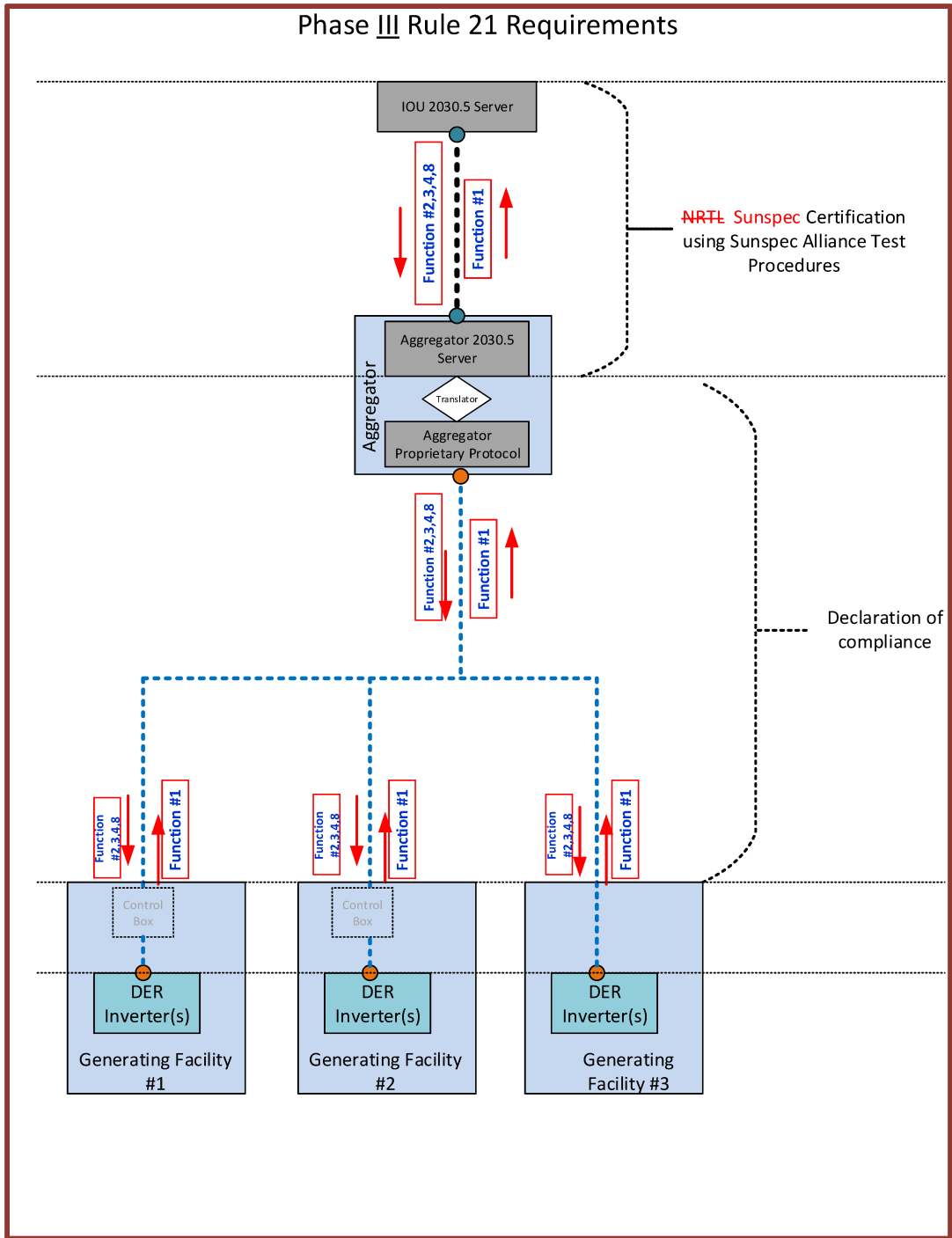


Table 2. Certified list of aggregators

Company Name	Aggregator Unique Identifier *	Date Listed	SunSpect Test Date	Notes
Green Power Company	Green Power 4512	9/26/2018	9/26/2018	XXX
Blue Power Company	Blue Power 6065	9/26/2018	9/26/2018	XXX
Orange Power Company	Orange Power 9550	9/26/2018	9/26/2018	XXX
Yellow Power Company	Yellow Power 4387	9/26/2018	9/26/2018	XXX



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**Attachment D**

**PG&E Implementation Plan**

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# Smart Inverter Phase II and Phase III (Function 1, 5, 6, 8) Implementation

## Background

Resolutions [E-4832](#) and [E-4898](#) respectively issued on April 6, 2017 and April 26, 2018, established effective dates for smart inverter Phase 2 communications protocols and Phase 3 advanced inverter functions.

On July 11, 2018, Edward Randolph of the CPUC's Energy Division sent a letter to Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE) and San Diego Gas & Electric Company (SDG&E), titled "Clarification of Deadlines for Adoption of Smart Inverters Phase 2 Requirements and Functions 1, 5, 6 and 8 of Phase 3."

The letter provides clarification of deadlines based on SunSpec Alliance's approval of the SunSpec Common Start Inverter Profile (CSIP) Conformance Test Procedures on May 22, 2018. The approval serves as the release of the SunSpec Alliance communication protocol certification test standard under Resolutions E-4832 and E-4898. Hence Phase 2 (communication capability) and Function 1, 5, 6, and 8 of Phase 3 will become mandatory<sup>1</sup> for generating facilities utilizing inverter-based technologies for which an interconnection request is submitted on or after February 22, 2019. This deadline is not contingent on and will not be affected by the release of another industry-recognized communication protocol certification test standard.

For your reference:

Function	Function Name
1	Monitor Key DER Data
5	Frequency Watt Mode (mandatory activation)
6	Volt Watt Mode (mandatory activation)
8	Scheduling Power Values and Modes

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<sup>11</sup> Mandatory in this context means that inverters installed on/after February 22, 2019 are required to be capable of providing Function 1 and Function 8 requirements, and inverters installed on/after February 22, 2019 are required to have Function 5 and Function 6 activated.

## Rule 21 Options

Electric Rule 21 has also been updated to reflect resolution requirements shown in the appendix

Rule 21 **Phase II requirement** for inverter based Generating Facilities shall be between:

- 1) Inverter or Inverter Control Unit; or
- 2) Energy Management System; or
- 3) Aggregator; or
- 4) Other as mutually agreed

Rule 21 **Phase III Function 1, 5, and 6 requirements** for inverter based Generating Facilities shall be at the **Inverter or Inverter Control Unit for a micro-inverter system**

Rule 21 **Phase III Function 8 requirement** for inverter based Generating Facilities shall be between:

- 1) Inverter or Inverter Control Unit; or
- 2) Energy Management System; or
- 3) Aggregator; or
- 4) Other as mutually agreed

## To populate a list of approved devices/aggregators:

For a Generating Facility to be considered compliant with Rule 21 requirements, the following eligible equipment lists are required for the application process. The following steps must be completed:

### Inverter Manufacturers or Inverter Control Unit (ICU) Manufacturers

- Function 5 & 6
  - Incorporate these functions within the inverter and work with a NRTL to receive certification that the inverter meets UL 1741-SA (function 5 and 6)
- Function 1 & 8
  - Incorporate this function and provide manufacturer declaration that these functions have been installed and have passed manufacturer's test for quality. This is a temporary solution until IEEE 1547.1 is approved which at that point, manufacturers will be required to work with a NRTL to receive certification to IEEE 1547.1.
- Phase II
  - Incorporate 2030.5 capability within the inverter and work with a NRTL to receive certification that the inverter meets SunSpec CSIP (2030.5)
- Send NRTL summary test reports and confirmation of certification and manufacturer's declaration (Function 1 & 8) to the CEC (pending confirmation from CEC)

### Energy Management System Manufacturers

- Function 8
  - Incorporate this function and provide manufacturer declaration that these functions have been installed and have passed manufacturer's test for quality. This is a temporary solution until IEEE 1547.1 is approved which at that point, manufacturers will be required to work with a NRTL to receive certification to IEEE 1547.1.
- Phase II
  - Incorporate 2030.5 capability and work with a NRTL to receive certification that the EMS meets SunSpec CSIP (2030.5)
- Send NRTL summary test reports and confirmation of certification and manufacturer's declaration (Function 8) to IOUs

### Aggregators

- Function 8
  - Incorporate this function so that the Aggregator meets SunSpec CSIP (function 8) and provide declaration that the aggregator's solution meets function 8 functional requirements. This is a temporary solution until IEEE 1547.1 is approved which at that point, aggregators will be required to work with a NRTL to receive certification to IEEE 1547.1.
- Phase II
  - Incorporate 2030.5 capability so that the Aggregator meets SunSpec CSIP (2030.5)

## Rule 21 Aggregator Conformance Process

- Rule 21 Aggregator to submit information to IOUs to be evaluated for the following but not limited to:
  - Phase II and Phase III capability and certification
  - Third Party Review including security
- PG&E reserves the right to require commissioning testing inclusive of an end-to-end test
- Rule 21 Aggregator to execute “Rule 21 Distributed Energy Resource Aggregation Agreement” (Issue 6 in Rule 21 OIR)

## DER Applications on/after Feb 22, 2019

For each DER application, they must select and indicate the following:

- Phase II – option 1-4 – indicate which option and the selected equipment
  1. Inverter or Inverter Control Unit; or
  2. Energy Management System; or
  3. Aggregator; or
  4. Other as mutually agreed
- Phase III Function 1, 5, and 6 – indicate model of inverter
  - Function 5 and 6 must be activated
  - To be indicated in Application and Interconnection Agreement
- Phase III Function 8 – option 1-4 – indicate which option and the selected equipment
  1. Inverter or Inverter Control Unit; or
  2. Energy Management System; or
  3. Aggregator; or
  4. Other as mutually agreed

For options that **do not** involve an aggregator, select a certified device in the interconnection process.

- This process will be very similar to the current interconnection process. Certified devices will move through the Fast Track review as a certified device and the certification and testing will be in accordance to Rule 21 Section L.2.a and L.5.d (Certified Equipment)

For options that **do** involve an aggregator, select an approved aggregator and which functions the aggregator will fulfill on behalf of DER (function 8, function 8 and 2030.5, or 2030.5 only)

- This process will be similar to the current interconnection process with a few key differences
    - The selected inverter or inverter control unit must be compliant with Phase 2 and 3 requirements
    - The aggregator must have completed the Rule 21 aggregator conformance process
    - The DER may be required to demonstrate via commissioning testing that Rule 21 requirements are met in accordance to Rule 21 Section L.5.f (Verification of Settings)
      - For example, this involves verification that the “Smart Inverter responds by changing its mode of operation as commanded at the schedule start time with no unreasonable delay.”
- The DER to execute the “Participating Generating Facility – Aggregation Agreement” (Issue 6 in Rule 21 OIR)

## Appendix: Rule 21 Excerpts from PG&E's Electric Rule 21

### Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

#### 5. COMMUNICATION REQUIREMENTS

- a. The communication protocol requirements included in this section Hh.5 shall become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted February 22, 2019, nine (9) months following the approval of the SunSpec Alliance Communication Protocol Certification Test Standard. Until such date, this subsection may be used in all or in part by inverter-based technologies by mutual agreement of the Distribution Provider and the Applicant. The communications requirements herein shall be between:
  - (i) the Distribution Provider and the individual Generating Facility's inverter control or energy management system;
  - (ii) the Distribution Provider and communication to the Generating Facility through an aggregator not co-located or part of the Generating Facility; or
  - (iii) other communication options as are mutually agreed to are by Applicant and the Distribution Provider.

### Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

#### 5. COMMUNICATION REQUIREMENTS (Cont'd.)

- b. Generating Facilities utilizing inverter-based technologies must adhere to all of the following communication protocol requirements for communications between Distribution Provider and communication option selected in section Hh. 5. This Rule does not specify the communication between the selected communication option and Smart Inverter but performance will be enforced by in compliance with this Rule:
  - (i) Shall be capable of communications;
  - (ii) Software shall be updateable via communications remotely;
  - (iii) The transport level protocol shall be TCP/IP; and,
  - (iv) The default application-level protocol shall be IEEE 2030.5 (i.e., Smart Energy Profile 2.0 (SEP 2)) as defined in the California IEEE 2030.5 Implementation Guide, but other application-level protocols may be used by mutual agreement of the parties including IEEE 1815/DNP3 for SCADA real-time monitoring and control and IEC 61850.

Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

5. COMMUNICATION REQUIREMENTS (Cont'd.)

- c. Additional communication protocol requirements shall also apply to Generating Facilities utilizing inverter-based technologies as provided in the following documents:
  - (i) Distribution Provider Generation Interconnection Handbook, which shall include:
    - a) Details and guidelines for the implementation of communications with Generating Facilities utilizing inverter-based technologies;
    - b) Cybersecurity and privacy requirements (these may additionally or alternatively be included in the application-level protocol implementation guide); and,
    - c) Generic device communications registration management requirements, including how to register individual Generating Facilities, Generating Facilities with energy management systems, and aggregators (these requirements additionally or alternatively may be included in the application-level protocol implementation guide).
  - (ii) Application-Level Protocol Implementation Guide, which shall provide:
    - a) Communication requirements and implementation guidelines to ensure consistent interoperability of the Generating Facilities with all California investor-owned utilities under the Commission's jurisdiction.



Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

6. SCHEDULING CAPABILITY REQUIREMENTS

- a. Generating Facilities which incorporate Smart Inverters shall incorporate scheduling capabilities with a minimum scheduling memory capability of at least 24 events. The capability for this requirement will be mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after February 22, 2019, nine (9) months following the approval of the SunSpec Alliance Communication Protocol Certification Test Standard.

The utilization of this function is permissible under mutual agreement between the utility and the generating facility before the effective date.

Each event is composed of modifications to each, selected group of, or all of the following Smart Inverter function.

- (i) Modifications to the voltage and reactive set-points of the Dynamic volt/var function.
- (ii) Modifications to the reactive power set-points for the fixed power factor function.
- (iii) Modifications to the voltage and watt-reduction level set-points for the volt/watt function.

Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

6. SCHEDULING CAPABILITY REQUIREMENTS (Cont'd.)

- b. The Generating Facility's scheduling capability requirement herein shall be met by one or more of the following options.
  - (i) Scheduling capability requirements may be stored at the Generating Facility Energy Management System (GFEMS). The GFEMS shall communicate the necessary commands to the Smart Inverters within 10 minutes from when GFEMS received the scheduling information.
  - (ii) Scheduling capability requirements may be stored at the Smart Inverter Control Unit (SMCU) within the Generating Facility. The SMCU shall communicate necessary commands to the Smart Inverters within 10 minutes from when SMCU received the scheduling information.
  - (iii) Scheduling capability requirements may be stored at an aggregator not co-located within the Generating Facility. The aggregator shall communicate the necessary commands to the Smart Inverters within 15 minutes of the aggregator receiving the scheduling information.
  - (iv) Other options may be utilized by mutual agreement between the Applicant and Distribution Provider.
- c. The selected scheduling control system shall store the schedules and shall send operational commands to the Smart Inverters as required by the schedule received from the Distribution Provider. The Smart Inverter shall respond by changing its mode of operation as commanded at the schedule start time with no unreasonable delay.

Each scheduled mode of operation shall include and start-time and duration. The Smart Inverter should return to its default settings at the end of the duration time or shall enter a new operational mode as directed by the scheduling control system.

Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

7. MONITORING AND TELEMETRY REQUIREMENTS

- a. The capability for this requirement will be mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after February 22, 2019, nine (9) months following the approval of the SunSpec Alliance Communication Protocol Certification Test Standard.

The utilization of this function is permissible under mutual agreement between the utility and the generating facility before the effective date.

Smart Inverter shall have the capability to communicate its performance information including:

- (i) Smart Inverter production or consumption of active power (Watts).
- (ii) Smart Inverter consumption or production of reactive power (VARs)
- (iii) Phase measured at the AC terminals of the Smart Inverter (Volts)
- (iv) Frequency measured at the AC terminals of the Smart Inverter (Hz)

Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

7. MONITORING AND TELEMETRY REQUIREMENTS (Cont'd.)

- b. When the Generating Facility includes energy-storage with Smart Inverters, the following monitoring and telemetry capability are required:
  - (i) The Smart Inverter shall be capable of communicating the percentage of energy-storage capacity. Operational energy of the energy storage system is the amount energy which can be used to support the energy needs of the electric system including the energy needs for the load within the generating facility or the Distribution System.
- c. Operational State as In-Service or not In-service communication capability requirements. The Smart Inverter shall be capable of communicating when the Smart Inverter is capable of providing electric services as follows:
  - (i) In-Service state: An operational state which indicates that the Smart Inverter is connected to the electric system and operating as determined locally by the Generating Facility operator or by a scheduling control system as outlined in section Hh.6
  - (ii) Not In-Service state: An operating state which indicates that the Smart Inverter is not capable of connecting to the electric system and not capable of providing any type of electrical support as required locally or as commanded by a scheduling control system as outlined in section Hh.



Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

7. MONITORING AND TELEMETRY REQUIREMENTS (Cont'd.)

- d. Monitoring and performance information should be communicated in aggregate at the Generating Facility as follows:
  - (i) When the Generating Facility includes only Smart Inverters: The production or consumption of active and reactive power shall be communicated as an aggregate of all Smart Inverters within the Generating Facility.
  - (ii) When a Generating Facility includes Smart Inverters and other technologies such as synchronous or induction generation systems, the Generating Facility should communicate the following:
    - a) The production or consumption of active and reactive power shall be communicated in aggregate of all Smart Inverters within the Generating Facility
    - b) The production or consumption of active and reactive power shall be communicated in aggregate of all the other technologies within the Generating Facility
  - (iii) When the Generating Facility with Smart Inverters includes one or multiple energy storage systems: The available operational energy should be communicated as an aggregate of all the energy storage systems.

Hh. SMART INVERTER GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS (Cont'd.)

8. CONTROL THROUGH COMMUNICATION CAPABILITIES

- a. The capability for these requirements will be mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted on or after the earlier of the dates shown in the "Table of Phase 3 Effective Dates Pursuant to Resolution E-4898" in Section Hh.2.q.

The utilization of these functions is permissible under mutual agreement between the utility and the generating facility before the effective date.

Smart Inverters shall have the capabilities of accepting an operational controls through communications in accordance to the following:

- (i) Cease to energize control command. When the Smart Inverter receives a cease-to-energize command through communication it must enter into a cease-to-energize state of operation or shall initiate the opening of the DER switch referenced in the ECP in order to galvanically isolate the DER system from the Distribution System
- (ii) Return to service control command. When the Smart Inverter receives a return-to-service control command, the Smart Inverter may return to service operation as required by Generating Facility operator or as required by the scheduling control system as required by section H.6
- (iii) Limit Active Power command. When the Smart Inverter receives a command to limit its production of real power, the Smart Inverter shall reduce its real power production to the specified percent of real power capacity of the Smart Inverter or to a specified real power value.
- (iv) Set Active Power Level Mode Function. The capability for this requirement will become mandatory for Generating Facilities utilizing inverter-based technologies for which an Interconnection Request is submitted twelve (12) months after approval of a nationally recognized standard that includes the function.
- (v) Suspension of Active Power restriction. When the Smart Inverter receives a command to suspend the command for active power reduction, the Smart Inverter may return to normal operation as required by Generating Facility operator or as required by the scheduling control system as required by section H.6.